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INSTRUMENT CLUSTER

The present invention relates to an instrument cluster having a printed circuit board on which a light source is provided in order to generate light for illuminating a display, and a frame in which the printed circuit board is held.

Such instrument clusters that are fitted in the dashboard of a vehicle in the visual range of the driver are known from motor vehicles. As a rule, they have a multiplicity of display panels that are accommodated in a common plastic housing and can be read off by the driver through a transparent cover. These instrument clusters provide both digital and analog display panels that display to the driver multifarious information such as, for example, vehicle speed, engine speed or tank filling level.

All the display panels share in common a dial with numerals or symbols that is arranged on the display panel and bears the luminous symbols required for identification. As a rule, the dial is a separate disk made from nonluminous material and to which an appropriate imprint for the individual variables to be displayed is applied. The display panels are arranged spaced apart in a defined fashion on a printed circuit board having a circuit arrangement and light-emitting light sources, and are surrounded by a frame having a transparent pane. The arrangement and number of the display panels to be used are determined by the number and position of the light sources to be arranged on the printed circuit board.

It is customary for this purpose to distribute the light sources behind the entire surface to be illuminated in order to ensure that the luminosity and luminance distribution of the display panels are as uniform as possible. Economizing with reference to the number of light-emitting light sources requires the use of particular light guides having light channels that, for example, guide the emitted light along a longitudinal direction and backlight the scale marks, for example, of a dial to be illuminated. As a rule, the size of the printed circuit board corresponds to the area of the display panels to be illuminated and consequently entails a high price and high manufacturing costs.

The display panels are arranged on a reflector and have a defined spacing from the printed circuit board. This determines a fixed overall height of the instrument cluster, and thus a requisite minimum installation depth in a dashboard.

It is an object of the present invention to provide an instrument cluster that has a small overall height, has a simple design and can be produced cost effectively, and whose display panels are illuminated with a homogeneous intensity of illumination.

The object is achieved according to the invention by virtue of the fact that the display panel is arranged directly on the printed circuit board, and a light guide is provided that is held in the frame in an area adjoining the printed circuit board, and the light guide is arranged in such a way that light emitted by the light source is fed into the light guide and radiated onto the display panel.

This has the advantage that it is no longer necessary for the individual display panels to be backlit since, because of the arrangement of the light sources and of the light guides surrounding the light sources, the emitted light is output in such a way that the display panels are illuminated from the front, that is to say the side facing the viewer. This results in a substantial reduction in the number of light sources and light channels. It is therefore possible to provide a printed circuit board that is populated on one side and permits the display panel to be arranged directly on the printed circuit board. Since there is no need to provide background lighting for the display panels, the latter need no longer be arranged at a spacing from the printed circuit board, and so the overall height of the instrument cluster can be substantially reduced.

The application of the display panel in the form of a dial, for example, directly on the printed circuit board results in the elimination and saving of the conventional fastening means for locking the display panels.

It is advantageous for a dial to be bonded onto the printed circuit board, or for a dial to be applied using a printing method. The dials can easily be fashioned in a variety of colors in order to improve distinction.

At the end facing the printed circuit board the frame has a light guide with an incoupling surface and outcoupling surface, the light guide deflecting the light between the incoupling surface and outcoupling surface. In an advantageous way, the end of the light guide that at least partially surrounds the light source forms the incoupling surface of the emitted light and leads the light at the required angle to the outcoupling surface at which the light is output and which illuminates the display panels arranged

on the printed circuit board. In this case, the outcoupling surface can be a multiple of the incoupling surface. The outcoupling surface of the light guide can extend over relatively large areas such that various illuminations, for example punctiform, strip-shaped or two-dimensional illuminations, are possible from the point of view of the display panel, depending on the radiation angle of the light source and/or the geometry of the outcoupling surface.

A particular cost advantage results on the basis of the single-piece production, for example, using the two-component injection-molding process, of the frame and of the light guide.

The invention is explained in more detail below with the aid of the exemplary embodiment illustrated in the figures. Identical or corresponding elements in the various figures are provided with identical reference numerals.

In the drawing:

figure 1 shows an exemplary embodiment of the instrument cluster according to the invention,

figure 2 shows a sectional illustration A-A of the instrument cluster illustrated in figure 1, and

figure 3 shows a further sectional illustration of the instrument cluster illustrated in figure 1.

Figure 1 shows a plan view of the instrument cluster 1 according to the invention. The instrument cluster 1 comprises a frame 31 and a housing rear wall 32, and surrounds two display panels 2 and warning panels 4 arranged below the display panels 2.

Outcoupling surfaces 92 of light guides 9 that are not illustrated here may be seen in the outer area on the inner wall of the frame 31, a uniform illumination of the display panels 2 being effected by the light, emanating from the frame 31, emitted from these outcoupling surfaces 92.

As may be seen from the sectional illustration A-A of figure 2 of the instrument cluster 1 illustrated in figure 1, it is possible to integrate into the instrument cluster 1 warning panels 4 that necessitate the conventional background lighting. As a rule, an instrument cluster 1 has individual warning panels 4, for example in order to display turn signals, hazard warning systems or lighting status, that inform the driver about normal or extraordinary operating states. The illumination of these warning panels 4 is enabled by further LEDs 7 that are arranged on a printed circuit board 5 and whose emitted light is guided via light guides 6, arranged on the rear side of the frame 31 of the instrument cluster 1, to the side of the frame 31 of the instrument cluster 1 that faces the viewer and on which an imprint of the warning panel 4 is placed at appropriate location.

A further sectional illustration through the instrument cluster 1 shown in figure 1 is illustrated in figure 3. The printed circuit board 5 is arranged on the housing rear wall 32 of the instrument cluster 1. Located directly on the printed circuit board 5 is a dial 10 that has been bonded onto the printed circuit board 5 or applied onto the printed circuit board 5 using the printing method. A light-emitting light source 8, preferably an LED, is mounted in the outer area of the printed circuit board 5. The frame 31 surrounds the printed circuit board 5 and components arranged on the printed circuit board 5. One end of the frame 31 has a light guide 9, the end of the light

guide 9 surrounding the LED 8 arranged on the printed circuit board, and serving as incoupling surface 91 for the emitted light. In this exemplary embodiment, the emitted light is deflected in the light guide 9 by an angle of 90° such that light emerges from the outcoupling surface 92 parallel to the display panels 2, and illuminates the surface of the display panels 2 homogeneously. However, the deflecting angle can be of any desired alignment such that, depending on what is required, the light need not be fed in parallel to the display panel 2. Since the light can be reflected at the outer inner side 93 of the light guide 9, it is possible on the basis of a freely dimensionable geometric shape of the light guide 9 to determine at which point and at which angle light fed into the incoupling surface 91 reemerges at the outcoupling surface 92.

As may be seen from figure 3, the overall height of the instrument cluster 1 can be substantially reduced because the display panels 2 are applied directly on the printed circuit board 5. A homogeneous illumination of the display panels 2 can be effected on the basis of the illumination of the display panels 2 via outcoupling surfaces 92 arranged in the frame 31. This leads to savings in component costs for fastening the display panels 2, and in the component costs for a multiplicity of LEDs 8 and in the outlay they require for the power supply.